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FACTSHEET

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INTRODUCTION

Farm machinery costs make up a significant part of the fixed and variable costs of any farm operation. If the capital invested in a machine is to be used efficiently, that machine must be used over enough acres or for enough hours to have costs comparable to or below the same operation being done by a custom operator. This Factsheet provides a framework for calculating the total annual cost of farm machinery so that you can determine whether or not it makes economic sense for you to own a machine. The best source of information to budget farm machinery costs is your records. In the absence of farm records, calculation methods can be used to estimate the costs. The estimates discussed in this Factsheet use an **economic engineering approach**. The information presented is prepared as a representative guide to estimating machinery costs and is not intended to recognize or predict the costs for any one particular operation. Terms in bold are explained in more detail in the section on Machinery Cost Budgeting Terms.

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MACHINERY COST BASICS AND CALCULATIONS

Machinery costs include fixed **(ownership)** costs and variable **(operating)** costs. These costs affect the profitability of the business.

Fixed Costs

Fixed costs do not change as the machine sees more use. They include depreciation, interest, insurance and housing. Fixed costs per unit of work done drop as the hours or acres of use per year increase.

Depreciation is a measure of the loss of value of a machine over time. **Straight line annual depreciation** is calculated by subtracting the trade-in value of the machine from the new cost and dividing the difference by the number of years between purchase and trade-in. The trade-in value or salvage value is the estimated value of the machine at the time of trade-in. Estimated trade-in values as a percent of new price are shown in *Table 1*. Inflation and equipment supply/demand factors can cause wide variation in these values.

Interest cost is the interest on the capital you have invested in the machine. The interest rate used should reflect conservative rates of return for money that could be obtained in the current market, e.g. T-Bill rate, GIC rate. If capital is in tight supply, you may want to choose a higher rate that gives you more of a return for the risk you assume in the investment.

Interest costs are calculated by adding the new cost plus the trade-in value of the machine, dividing by two to give an average value over the machine's life, and then multiplying by the chosen interest rate.

Insurance and housing make up a small part of the ownership costs of a machine. Insurance costs can be calculated using the same formula as interest costs given above but substituting the chosen interest rate with the chosen **insurance rate**. Housing costs are estimated by multiplying the housing rate per square foot by the square feet of housing required. The current market building rental rate per square foot is a good estimate for the housing rate. Housing requirements of selected farm equipment are shown in *Table 2*. If the insurance and housing rates are not known, 1% of the new cost can be used to estimate annual insurance and housing costs.

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TABLE 1. Trade-In Values as a Percentage of New Cost

End of Year	Tractors			Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
	<80 hp	80-149 hp	150+ hp							
1	60	68	67	74	49	56	65	47	61	69
2	54	61	59	62	44	50	60	44	54	62
3	50	57	54	54	40	46	56	42	49	56
4	46	53	49	48	37	42	53	40	45	52
5	43	49	45	43	35	39	50	39	42	48
6	41	46	42	38	32	37	48	38	39	45
7	38	44	39	34	30	34	46	36	36	42
8	36	41	36	31	28	32	44	35	34	40
9	34	39	34	28	27	30	42	34	31	37

10	33	37	32	25	25	28	40	33	30	35
11	31	35	30	23	24	27	39	32	28	33
12	29	33	28	20	23	25	38	32	26	31
13	28	32	26	18	21	24	36	31	24	29
14	27	30	24	17	20	22	35	30	23	28
15	25	29	23	15	19	21	34	29	22	26
16	24	28	21	13	18	20	33	29	20	25
17	23	26	20	12	17	19	32	28	19	24
18	22	25	19	10	16	18	30	27	18	22
19	21	24	18	9	16	17	29	27	17	21
20	20	23	17	8	15	16	29	26	16	20

Source: *American Society of Agricultural Engineers Standards, American Society of Agricultural Engineers, 1999*

Group 1: Combines, self-propelled forage harvesters.

Group 2: Swathers, mower-conditioners, rotary hay mowers, rotary mower-conditioners.

Group 3: Forage harvesters, balers, bale elevators, tub grinders, augers, grinder-mixers, forage boxes, roller mills.

Group 4: Planters, drills, sprayers.

Group 5: Moldboard plows, chisel plows, cultivators, v-rippers.

Group 6: Disks, harrows, hoes.

Group 7: Manure spreaders, miscellaneous equipment.

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TABLE 2. Housing Requirements of Selected Farm Equipment

	Sq. ft required		Sq. ft required
4–18 in. Furrow Plow	75	20 ft No–Till Drill	200
6–18 in. Furrow Plow	132	30 ft Sprayer	150
8–18 in. Furrow Plow	150	50 ft Sprayer	200
12.5 ft Field Cultivator	175	9 ft Mower Conditioner	100
18 ft Field Cultivator	200	9 ft Rotary Mower/Conditioner	100

37 ft Field Cultivator	350	Square Baler	184
11 ft Chisel Plow	200	Round Baler 1000 lbs.	100
15 ft Chisel Plow	225	Round Baler 1500 lbs.	115
11 ft Tandem Disk	160	Large Size Square Baler	250
15 ft Tandem Disk	210	Round Baler 1000 lb/Wrapper	100
4R – 36 in. Row Crop Planter	150	2–Row Forage Harvester	140
6R – 30 in. Row Crop Planter	170	Large Forage Blower	30
12R – 30 in. Row Crop Planter	300	Combine 190 hp Corn Hd 4R–30 in.	380
4R – 36 in. Minimum–Till Planter	150	Combine 275 hp Corn Hd 12R–30 in.	660
6R – 30 in. Minimum–Till Planter	170	Combine 220 hp Grain Hd 20 ft	478
8R – 30 in. Minimum Till	200	Combine 275 hp Grain Hd 30 ft	590
25 ft Grain Drill	130	Combine 220 hp Soybean Hd 15 ft	478
35 ft Grain Drill	200	Combine 275 hp Soybean Hd 25 ft	608
12 ft Presswheel Drill	115	Tractors less than 80 hp	105
20 ft Presswheel Drill	130	Tractors 80–149 hp	130
15 ft No–Till Drill	160	Tractors 150+ hp	240

Source: *Minnesota Farm Machinery Economic Cost Estimates for 2000, University of Minnesota, Department of Applied Economics, 2000*

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TABLE 3. Accumulated Repair Costs as a Percent of Purchase Price

Machine	1/4% LIFE Accumulated Hours-Costs	1/2% LIFE Accumulated Hours-Costs	3/4% LIFE Accumulated Hours-Costs	FULL LIFE Accumulated Hours-Costs
2 Wheel Tractors	3000 - 6.2%	6000 - 25.0%	9000 - 56.2%	12000 - 100%
4 WD and MFWD Tractors	4000 - 4.8%	8000 - 19.2%	12000 - 43.2%	16000 - 80%
Self Propelled Combines	750 – 2.2%	1500 - 9.3%	2250 – 21.9%	3000 – 40%
Planters, Drills	375 – 4.1%	750 - 17.5%	1125 – 41.0%	1500 – 75%
Moldboard Plows	500 – 8.3%	1000 - 28.7%	1500 – 59.6%	2000 – 100%
Disk, Disk Harrows	500 – 5.5%	1000 - 18.0%	1500 – 35.9%	2000 – 60%
Chisel Plows	500 – 10.1%	1000 - 26.5%	1500 – 46.8%	2000 – 75%
Cultivators	500 – 10.2%	1000 - 27.0%	1500 – 47.6%	2000 – 70%

Mowers	500 – 14.2%	1000 - 46.2%	1500 – 92.0%	2000 – 150%
Square Balers, Small	500 – 6.6%	1000 - 23.0%	1500 – 47.7%	2000 – 80%
Square Balers, Large	750 – 6.0%	1500 - 20.7%	2250 – 43.0%	3000 – 75%
Large Round Balers	375 – 7.4%	750 - 25.9%	1125 – 53.6%	1500 – 90%
SP Forage Harvesters	1000 – 3.1%	2000 - 12.5%	3000 – 28.1%	4000 – 50%
Rakes	625 – 8.6%	1250 - 22.7%	1875 – 40.1%	2500 – 60%
Source: American Society of Agricultural Engineers Standards, American Society of Agricultural Engineers, 1999				

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Variable Costs

Variable costs increase as the machine sees more use and include repairs, fuel and lubricants, and labour.

Repair costs are relatively low early in the life of a machine, but repair costs rise as a machine ages. **Accumulated repair costs** as a percent of new cost are shown in *Table 3*. Storing machines inside helps reduce the rate of weathering and wear, and also slows down the visual signs of aging.

Accumulated Repair Cost Example

Large Round Baler New Cost $20,000

Projected use: 300 acres or 75 hours per year over 10 years

Estimated accumulated repair costs at 750 hours are 25.6% of new cost.

Repair costs will be approximately $5,124 over 10 years (25.6% of $20,000) or about 2.6% of new cost per year.

Used Machinery: When calculating the depreciation on used machinery, use the actual price paid for the machine minus its expected trade-in or salvage value, divided by the expected life of the machine on your farm. Increase repair rates to levels appropriate for the age or number of hours on the machine. Expect to have higher than normal repair expenses in the first year of ownership of a used machine as you bring it back into top operating shape.

Fuel, oil and lubrication costs vary with the annual use of the machine and its maintenance schedule. Lubrication costs add approximately 15% to fuel costs. The best source of information for fuel use is past records. If these records are unavailable, calculate annual fuel consumption using the following method:

Average Gasoline Consumption (litres/hour)

= (0.229) × maximum PTO horsepower per hour

Diesel units will use approximately 73% less fuel than gasoline units.

Average Diesel Fuel Consumption (litres/hour)

= (0.229) × maximum PTO horsepower/hr × (0.73) or

= (0.167) × maximum PTO horsepower

The maximum PTO horsepower per hour can be obtained from the **Nebraska Tractor Test Data** published by the Nebraska Tractor Test Laboratory, University of Nebraska. If the maximum PTO horsepower for a particular tractor is not known, the advertised PTO horsepower per hour or the Nebraska Tractor Test Data for a tractor with similar displacement can be used.

The performance, fuel and horsepower requirements of selected farm equipment are shown in *Table 4.*

Fuel and lubrication costs

litres of fuel used/hr × hours of use/yr × fuel cost/L × 1.15

This table does not account for the variation in rates of work or horsepower requirements caused by differences in soil type, topography, field shape, and drainage or equipment operators.

TABLE 4. Performance, Horsepower and Fuel Requirements of Selected Farm Equipment

	HP required	Acres/hour	Litres/ac	Litres/hour
4–18 in. Furrow Plow	75	2.8	4.5	12.5
6–18 in. Furrow Plow	130 MFWD	4.2	5.1	21.6
8–18 in. Furrow Plow	160	5.6	4.7	26.5
12.5 ft Field Cultivator	75	9.0	1.4	12.5
18 ft Field Cultivator	105 MFWD	13.0	1.3	17.4
37 ft Field Cultivator	225	26.7	1.4	37.5
11 ft Chisel Plow	75	5.9	2.1	12.5
15 ft Chisel Plow	130 MFWD	8.0	2.7	21.6
11 ft Tandem Disk	60	6.4	1.5	9.9
15 ft Tandem Disk	105 MFWD	8.7	2.0	17.4
4R – 36 in. Row Crop Planter	40	5.6	1.2	6.8
6R – 30 in. Row Crop Planter	60	7.0	1.4	9.9
12R – 30 in. Row Crop Planter	105 MFWD	14.0	1.2	17.4
4R– 36 in. Minimum–Till Planter	60	5.1	1.9	9.9
6R–30 in. Minimum–Till Planter	75	6.4	2.0	12.5
8R–30 in. Minimum Till Planter	105 MFWD	8.5	2.1	17.4

25 ft Grain Drill	130 MFWD	4.7	4.6	21.6
35 ft Grain Drill	160 MFWD	14.9	1.8	26.5
12 ft Presswheel Drill	75	5.1	2.5	12.5
20 ft Presswheel Drill	130 MFWD	8.5	2.5	21.6
15 ft No–Till Drill	130 MFWD	6.4	3.4	21.6
20 ft No–Till Drill	160 MFWD	8.5	3.1	26.5
30 ft Sprayer	40	15.4	0.4	6.8
50 ft Sprayer	60	25.6	0.4	9.9
9 ft Mower Conditioner	40	4.4	1.6	6.8
9 ft Rotary Mower/Conditioner	75	6.6	1.9	12.5
Square Baler	40	4.4	1.6	6.8
Round Baler 1000 lbs.	60	3.0	3.3	9.9
Round Baler 1500 lbs.	60	4.0	2.5	9.9
Large Size Square Baler	130 MFWD	16.3	1.3	21.6
Round Baler 1000 lb/Wrapper	60	3.0	3.3	9.9
2–Row Forage Harvester	105 MFWD	1.4	12.5	17.4
Large Forage Blower	60			9.9
Combine 4R–30 in. Corn Hd	190	2.8	11.4	31.8
Combine 12R–30 in. Corn Hd	275	7.6	6.0	45.9
Combine Grain Head 20 ft	220	6.8	5.4	36.8
Combine Grain Head 30 ft	275	10.2	4.5	45.9
Combine Soybean Head 15 ft	220	4.5	8.2	36.8
Combine Soybean Head 25 ft	275	7.4	6.2	45.9
Source: *American Society of Agricultural Engineers Standards, American Society of Agricultural Engineers, 1999*				

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Labour costs are a consideration in any budget, but the value used will depend on the situation. Estimate the labour rate for the owner/operator using the **opportunity cost** for use of time. A constant rate for hired labour is appropriate. The rate should not be less than the typical labour rate for the area. Add labour costs where you feel it is justified.

There is one fundamental rule that must be followed to justify the ownership of any machine: **USE IT**. Machinery is expensive and ties up large amounts of capital. If a machine is to be cost-effective, it must see enough hours of use annually to have fixed and variable costs below the cost of the same operation being done via alternatives to purchasing.

Consider the combine shown in *Table 5* at 3 different levels of annual use.

This does not account for the issue of when the custom operator can arrive at your farm. For many, the benefits have to be better than breakeven for them to hire a custom operator over ownership due to the control over when the crop is harvested. This same principle applies for any farm operation that requires timely access to machinery. Planting and harvesting are two primary operations that, if delayed, can have a significant affect on yield and quality. Farms harvesting less than 840 acres should consider alternatives to purchasing the new machine.

TABLE 5. Example: Annual Fixed and Variable Costs of $220,000 Combine at Three Levels of Use

Hours Per Year	100	200	300
Acres Per Year	840	1680	2520
Fixed Costs Per Year	$24,888	$24,888	$24,888
Variable Costs Per Year	$5,067	$11,964	$20,837
Total Annual Costs	$29,955	$36,851	$45,725
Annual Cost Per Acre	$35.66	$21.94	$18.14
Custom Combine Per Acre[1]	$32.25	$32.25	$32.25

The breakeven for purchasing versus hiring a custom operator in this case is around 955 acres

[1] Custom Farmwork and Equipment Rental Survey Results, OMAFRA, 2000

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TABLE 6. EXAMPLE: Annual Cash Fixed and Variable Costs of $220,000 Combine at Three Levels of Use

Hours Per Year	100	200	300
Acres Per Year	840	1,680	2,520
Variable Costs Per Year	$5,067	$11,964	$20,837
Cash Fixed Costs	$33,050	$33,050	$33,050

Total Annual Cash Costs	$38,117	$45,014	$53,887
Annual Cash Cost Per Acre	$45.38	$26.79	$21.38
Custom Combine Per Acre	$32.25	$32.25	$32.25
The breakeven would be around 1290 acres			

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Annual Cash Costs Based on Repayment

Cash costs estimate the impact of the purchase and its use on annual cash flow. Tax savings can be considered when applicable. If we take the debt servicing requirements of the combine in *Table 5* and add a return on investment for the interest lost on the down payment invested, here is what the annual cash costs of this machine would be:

Combine — New Cost $220,000

Down Payment — $55,000 @ 4.5% = $2,025

Finance — $165,000 @ 7.25%, 7 yrs. = $31,025

Total Annual Cash Fixed Costs = $33,050

The resulting change in breakeven when considering annual cash costs is shown in *Table 6.*

Highly profitable operations would be able to justify covering fewer acres because of the additional tax savings from the **capital cost allowance** on the combine. CCA expense for this machine at 30% would be $42,075 in the second year of ownership. Tax savings, depending on the marginal tax rate of the individual or corporation that owns the machine, could range from nothing to about $19,500.

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ALTERNATIVES TO PURCHASING MACHINERY

The 3 most common alternatives to purchasing machinery are leasing, equipment rental or hiring custom farmwork.

Leasing Farm Equipment

An increasingly popular option to consider when acquiring farm machinery is leasing farm equipment. The popularity of leasing is in part due to the increasing cost of machinery and the outlay of large amounts of capital. See OMAFRA Factsheet *Leasing Farm Equipment*, Order No. 01-003.

Custom Farmwork and Machinery Rental

Hiring custom farmwork provides an option to farmers to purchase the service instead owning the equipment and doing the work. Custom farmwork operators are well advised to calculate their own machinery costs to ensure they are covering their costs plus a return for their risk and time. A survey of Ontario Custom Farmwork and Equipment Rental Rates is conducted regularly by OMAFRA. The latest Custom Farmwork and Rental Rates Charged in Ontario summary is available from the

OMAFRA Business Development Web site at: www.gov.on.ca/OMAFRA/english/busdev/agbusdev.html.

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DECISION-MAKING AIDS

Machinery Tools

The Machinery Tools worksheet contains a machinery cost calculator, cost charts, factsheets on machinery tax and budgeting, and a comparison worksheet that looks at machinery replacement options including purchase, repair, lease and custom hire. An Excel worksheet, it also has a simple cash basis lease worksheet.

Equipment Lease Analyzer

It is a decision-making aid to help evaluate the economic differences between purchasing and leasing equipment.

The Machinery Tools and Equipment Lease Analyzer spreadsheets can be downloaded from the OMAFRA Business Development Web site at Computer Management Tools, www.gov.on.ca/OMAFRA/english/busdev/ agbusdev.html.

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MACHINERY COST BUDGETING TERMS

Accumulated repair costs — total cost of repairs that have been incurred over the life of the machine to date.

Capital cost allowance — an amount (expressed as a %) allowed to be expensed for tax purposes against the cost of capital assets acquired by a business. Different types of assets attract different percentages.

Depreciation, straight line — a method in which equal amounts of depreciation expense is budgeted for each time period over the economic life of the asset.

Economic engineering approach — the American Society of Agricultural Engineers' Farm Machinery Management Committee publish standards for Agricultural Machinery Management. Formulas based on representative values of farm machinery operation parameters are developed to assist in estimating the performance of field machinery.

Economic Life (useful life) — the period of time during which an asset has economic value and is usable.

Insurance rate — percentage of the value charged by commercial insurance companies to insure the machinery investment.

Lease — a contract for the use of machinery for an agreed period of time in return of periodic payments. Ownership remains with the lessor. The lessee acquires the right of temporary possession and use.

Nebraska Tractor Test Data — Tractors are tested at the University of Nebraska Tractor Test Laboratory under similar conditions to provide a means of comparison of performance of different tractor makes and models.

Operating costs — variable costs, costs that depend directly on the amount of machine use.

Opportunity Cost — the potential benefit that is lost by choosing one good or service at the expense of giving up another good or service. For example, if a farmer could earn a salary of $ 40,000 by working off the farm, $40,000 would be the opportunity cost of choosing to work on the farm.

Ownership costs — fixed costs, costs that do not depend on the amount of machine use.

Total annual cost — the sum of fixed (ownership) and variable (operating) costs.

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TABLE 7: Machinery Cost Calculation Worksheet

MACHINE:	NEW PRICE:
LIFE (YEARS):	TRADE-IN VALUE:
INTEREST RATE:	HOURS PER YEAR:
ACRES PER YEAR:	FUEL COST PER LITRE:
RATE OF WORK (ACRES/HOURS):	FUEL USE (LITRES PER HOURS):
ANNUAL LOAN PAYMENTS:	DOWN PAYMENT:

ANNUAL COSTS

VARIABLE COSTS PER YEAR		
FUEL AND LUBRICANTS = LITRES per hour x HOURS per year x FUEL COST per litre x 1.15		
= _____ x _____ x _____ x 1.15		= $ _____
REPAIRS = NEW PRICE x % RATE (BASED ON ACCUMULATED HOURS)		+
= $ _____ x ____ %		= $ _____
LABOUR (OPTIONAL) = WAGE RATE x HOURS per year		+
	= $_____/hr x _____hours	= $ _____
	TOTAL VARIABLE COSTS PER YEAR	= $ _____
FIXED COSTS PER YEAR		
DEPRECIATON = NEW PRICE – TRADE-IN VALUE = $_____-$_____		= $ _____
LIFE (YEARS)	YEARS	
INTEREST = NEW PRICE + TRADE-IN VALUE x INTEREST		+
2	RATE	
= ($_____ + $_____ x _____%		+ $ _____
USE EITHER METHOD 1 OR METHOD 2 to calculate Insurance and Housing		
METHOD 1	INSURANCE = NEW PRICE + TRADE-IN VALUE / 2 X INSURANCE RATE	= $ _____
	HOUSING = SQUARE FEET REQUIRED x HOUSING RATE	= $ _____
METHOD 2	INSURANCE AND HOUSING = NEW PRICE x 1.0%	= $ _____ x 1.0%
		= $ _____
	TOTAL FIXED COSTS PER YEAR	= $ _____
TOTAL ANNUAL COST = FIXED COSTS + VARIABLE COST + $_____ + $_____		= $ _____
COST PER ACRE = TOTAL ANNUAL COSTS / ACRES per year = $ _____ / ACRE		= _____ per acre

ANNUAL CASH COSTS FOR TERM OF LOAN

ANNUAL PAYMENTS ON LOAN	= $_____ +
DOWN PAYMENT x INTEREST RATE	= $_____ +
TOTAL VARIABLE COSTS per year	= $_____
TOTAL (PRE-TAX) CASH COSTS per year	= $_____
CASH COSTS per acre = TOTAL CASH COSTS per year / ACRES per year = $_____ / ACRE	= $_____ per acre

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